

Evaluating Traumatic Brain Injury: History and Examination in the Clinic or Hospital Setting

Ronald G. Riechers, II, M.D.

Medical Director

Polytrauma Team, Cleveland VA

Assistant Professor of Neurology

Case Western Reserve University

Disclaimer

- The opinions or assertions contained herein are the private views of the author and are not to be construed as reflecting the views of the Department of Veterans Affairs or the Department of Defense.

Overview

- Acute assessment of TBI
 - Historical features
 - Examination
- Evaluating the historical TBI
 - Obtaining event history
 - Assessing current complaints
 - Physical exam

DoD Definition for TBI

Traumatic brain injury (TBI) is a traumatically-induced structural injury and/or physiological disruption of brain function as a result of an external force that is indicated by new onset or worsening of at least one of the following clinical signs, immediately following the event:

- (1) Any period of loss, or a decreased level, of consciousness.
- (2) Any loss of memory for events immediately before or after the injury.
- (3) Any alteration in mental state at the time of the injury (confusion, disorientation, slowed thinking, etc.).
- (4) Neurological deficits (weakness, loss of balance, change in vision, praxis, paresis/plegia, sensory loss, aphasia, etc.) that may or may not be transient.
- (5) Intracranial lesion.

Severity Rating for TBI

Traumatic Brain Injury Description

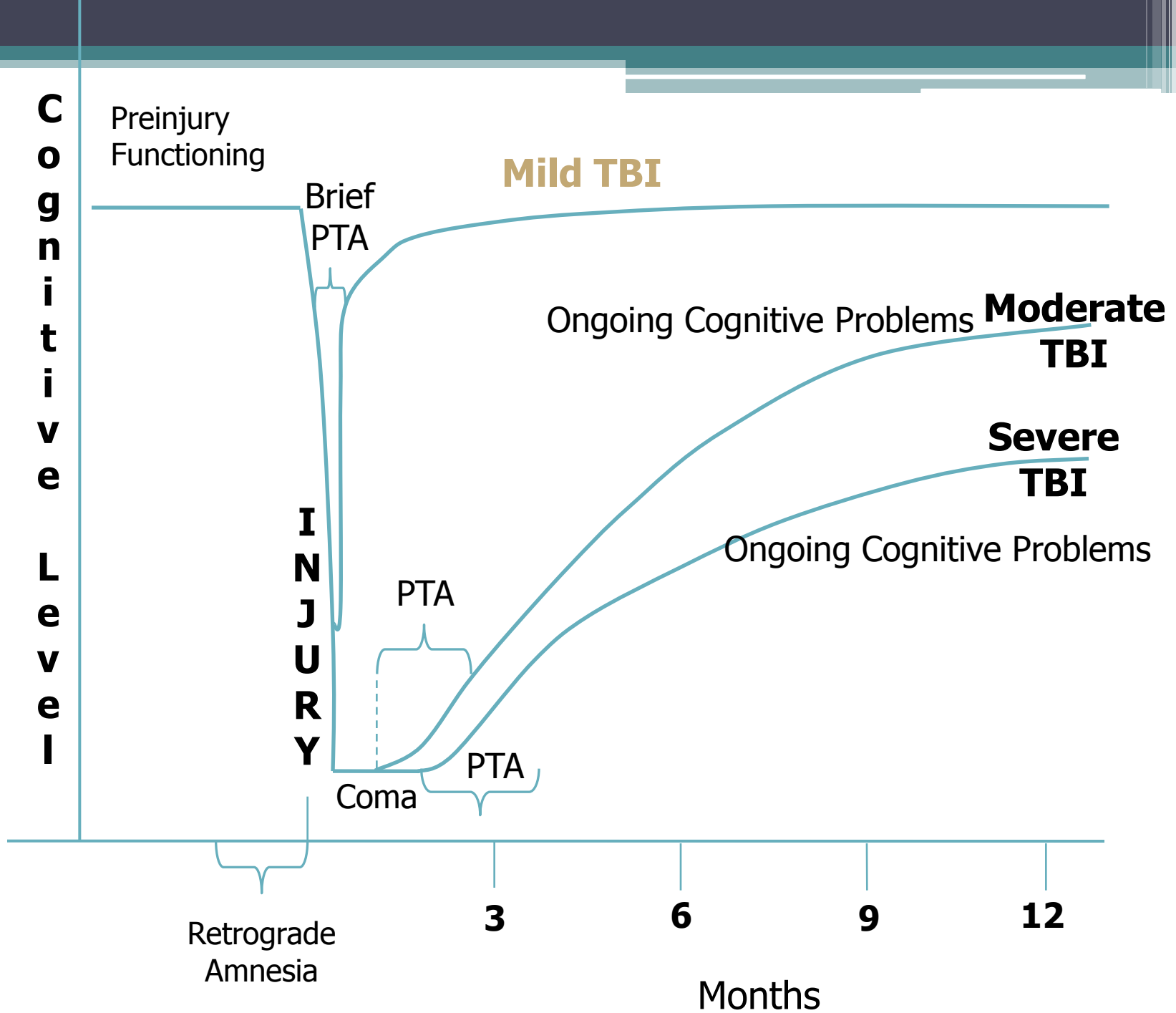
Severity	GCS	AOC	LOC	PTA
Mild	13-15	≤24 hrs	0-30 min	≤24 hrs
Moderate	9-12	>24 hrs	>30min <24 hrs	>24hrs <7 days
Severe	3-8	>24hrs	≥24 hrs	≥7 days

GCS- Glasgow Coma Score

LOC -Loss of consciousness

AOC- Alteration in consciousness

PTA- Post-traumatic amnesia



Clinical Presentation - Acute mTBI

- Appear stunned, dazed, drowsy, or apathetic
- Disoriented, difficulty following complex commands
- Complain of headache, nausea, vomiting, and/or dizziness

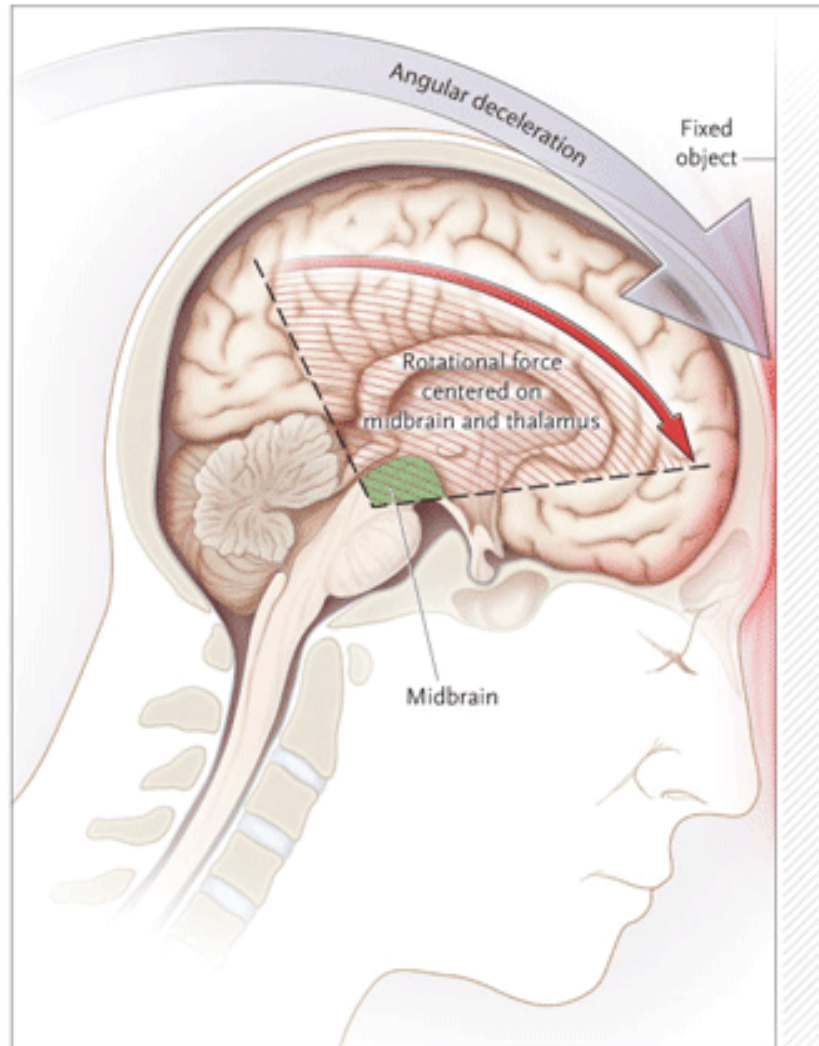
Clinical Presentation - Acute mTBI

Table 1

University of Pittsburgh signs and symptoms of concussion

Signs observed by staff	Symptoms reported by athlete
Appears to be dazed or stunned	Headache
Is confused about assignment	Nausea
Forgets plays	Balance problems or dizziness
Is unsure of game, score, or opponent	Double or fuzzy/blurry vision
Moves clumsily	Sensitivity to light or noise
Answers questions slowly	Feeling sluggish or slowed down
Loses consciousness	Feeling “foggy” or groggy
Shows behavior or personality change	Concentration or memory problems
Forgets events prior to play (retrograde)	Change in sleep pattern (appears later)
Forgets events after hit (posttraumatic)	Feeling fatigue

Acute Symptoms - Why?



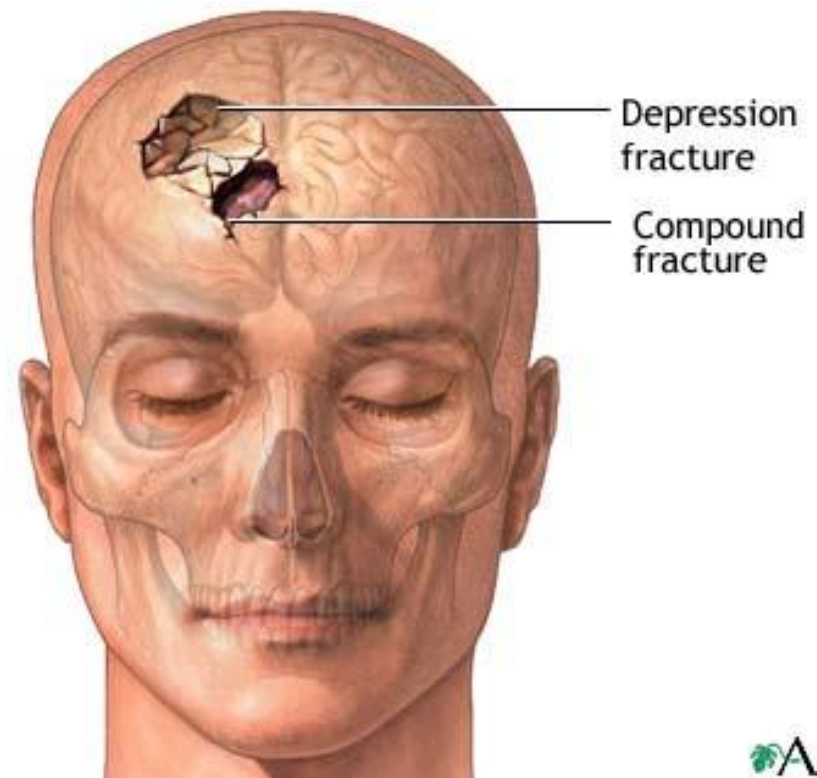
Ropper AH et al. NEJM 2007.

Clinical Presentation - Acute moderate-severe TBI

- Comatose
- Delirious or combative
- Focal Neurologic deficits
 - Paralysis
 - Aphasia
 - Visual impairment

General Exam

- Depressed Skull Fractures
- CSF leak



Basilar Skull Fracture Signs

- Raccoon Eyes



- Battle's Sign



Basilar Skull Fracture Signs

- Hemotympanum



Bist SS et al. Ear Nose Throat J. 2007.

*Deguine J et al. Ear Nose Throat J.
2003*



Acute Examination - Severe TBI

- Glasgow Coma Scale
 - Eye Opening
 - Motor Response
 - Verbal Response

Eye Opening

Response	Point Value
Spontaneous	4
To voice	3
To pain	2
None	1

Motor Response

Response	Points
Follows commands	6
Localizes to pain	5
Withdrawal to pain	4
Decorticate posturing	3
Decerebrate posturing	2
No response to pain	1

Verbal Response

Response	Points
Oriented	5
Confused	4
Inappropriate words	3
Incomprehensible sounds	2
None	1

Coma Examination

- Observation
- Brain stem function
- Motor/Sensory function
- Reflexes

Observation

- Respiratory patterns
- Spontaneous motor activity
 - Seizures
 - Posturing
 - Eye deviation

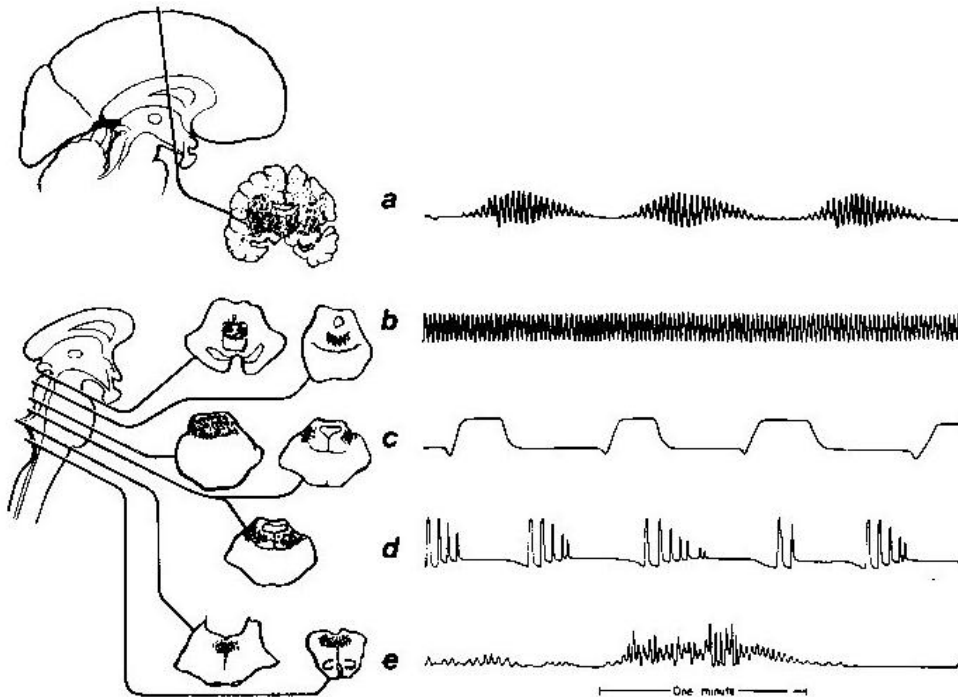


Figure 6. Abnormal respiratory patterns associated with pathologic lesions (shaded areas) at various levels of the brain. Tracings by chest-abdomen pneumograph, inspiration reads up. **a**, Cheyne-Stokes respiration. **b**, Central neurogenic hyperventilation. **c**, Apneusis. **d**, Cluster breathing. **e**, Ataxic breathing.

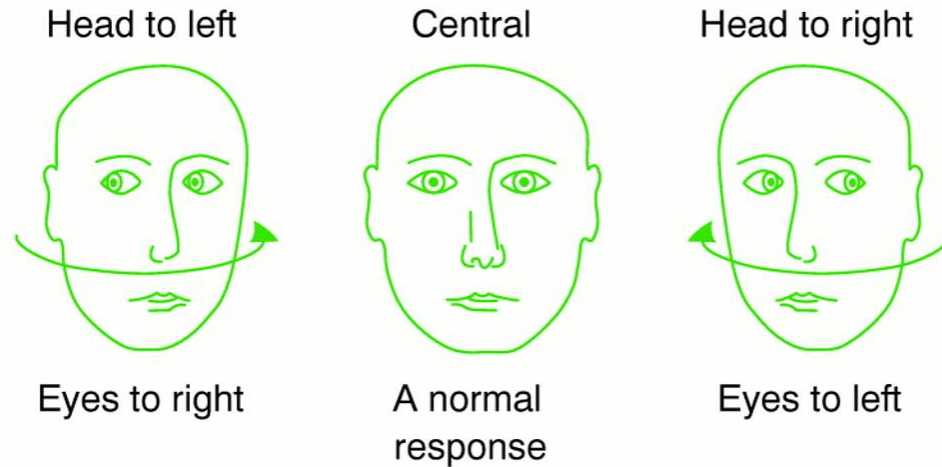
*Plum and Posner.
Stupor and Coma. 1982*

Brainstem Exam

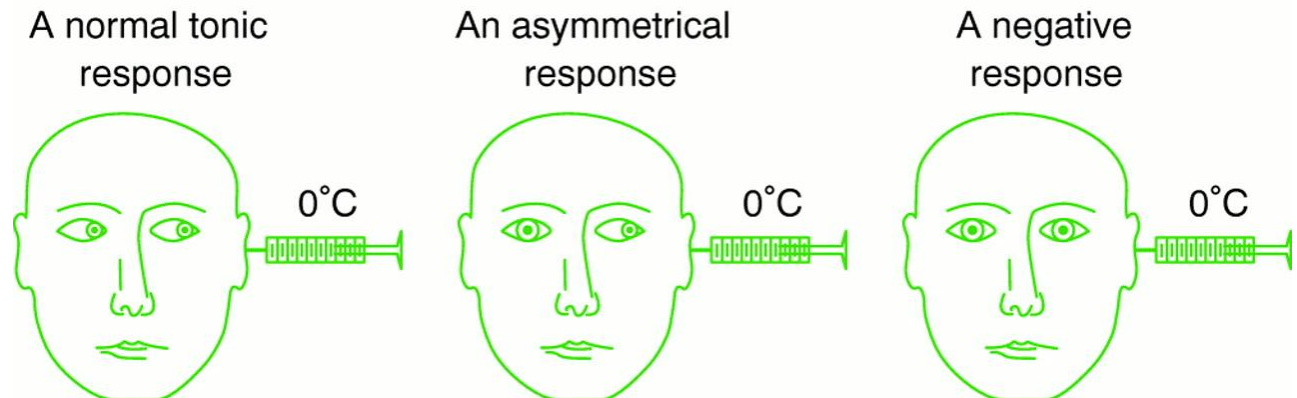
- CN 2 Response to threat
- CN 3,4,6,8 Oculo-cephalic reflex
- CN 5,7 Corneal reflex
- CN 9,10 Gag reflex

Oculo-Cephalic Reflex

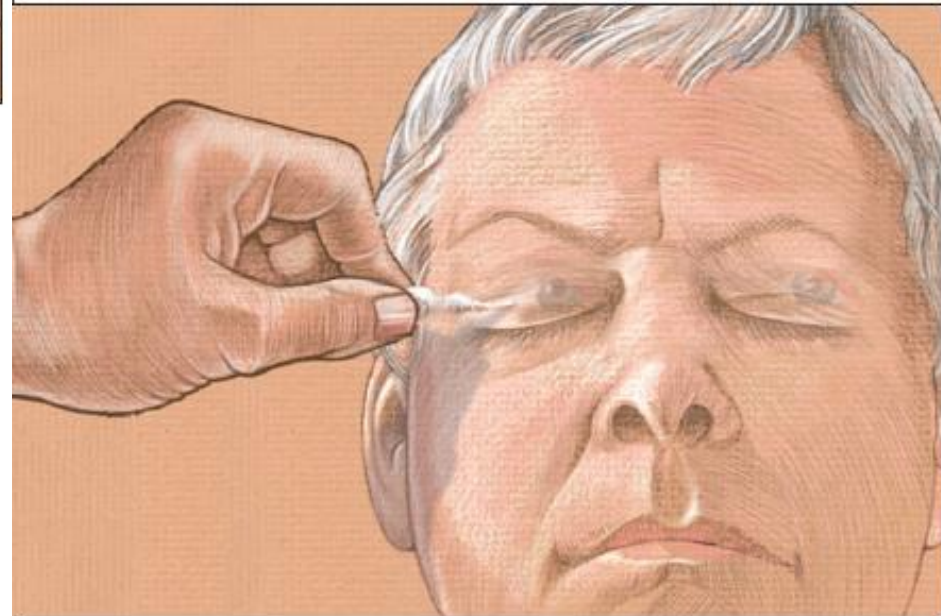
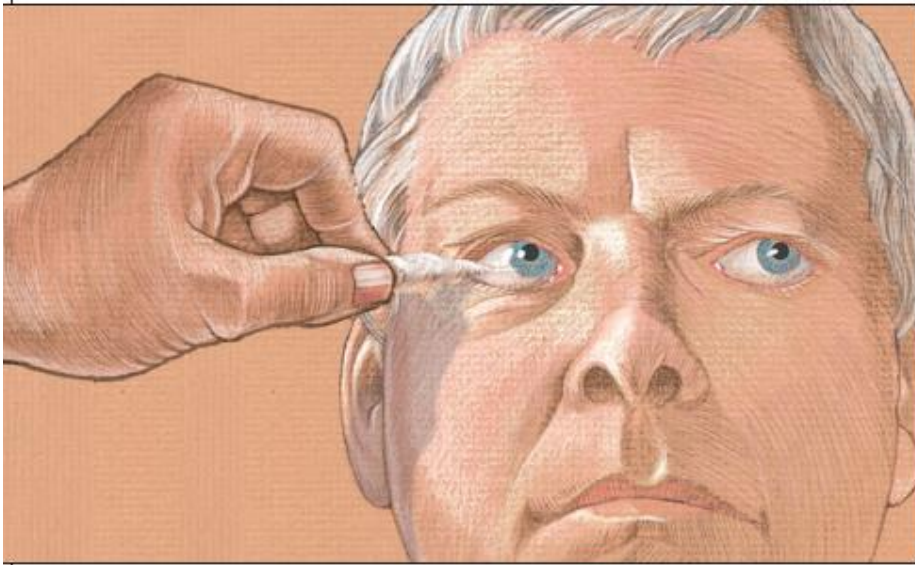
Oculocephalic (Doll's eye)



Caloric responses



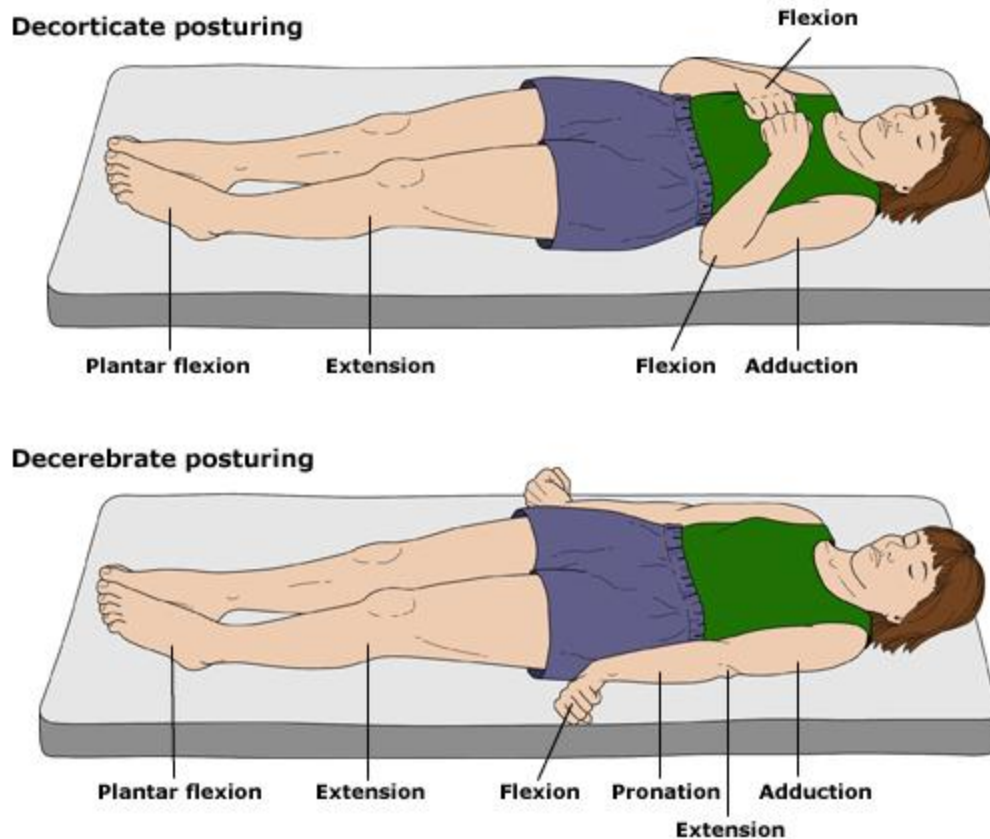
Corneal Reflex



Pullen RL. Nursing. 2005;35(11):68.

Motor Sensory Examination

- Posturing vs. withdrawal vs. localizing



*Bateman DE.
JNNP 2001*

Reflexes

- Deep tendon reflexes
- Plantar reflex/Babinski



Signs of Psychogenic Unresponsiveness

- Forced eye closure
- Nystagmus on caloric testing
- Active resistance to movement
- Avoidance of self injury
- Catatonia/Waxy flexibility

Acute Evaluation - mTBI



Military Acute Concussion Evaluation (MACE)

Defense and Veterans Brain Injury Center

Patient Name: _____

SS#: _____ Unit: _____

Date of Injury: ____/____/____ Time of Injury: _____

Examiner: _____

Date of Evaluation: ____/____/____ Time of Evaluation: _____

History: (I – VIII)

I. Description of Incident

Ask:

- What happened?
- Tell me what you remember.
- Were you dazed, confused, "saw stars"? ☐ Yes ☐ No
- Did you hit your head? ☐ Yes ☐ No

II. Cause of Injury (Circle all that apply):

- Explosion/Blast
- Blunt object
- Motor Vehicle Crash
- Fragment
- Fall
- Gunshot wound
- Other _____

III. Was a helmet worn? ☐ Yes ☐ No Type _____

IV. Amnesia Before: Are there any events just BEFORE the injury that are not remembered? (Assess for continuous memory prior to injury)

☐ Yes ☐ No If yes, how long _____

V. Amnesia After: Are there any events just AFTER the injuries that are not remembered? (Assess time until continuous memory after the injury)

☐ Yes ☐ No If yes, how long _____

VI. Does the individual report loss of consciousness or "blacking out"? ☐ Yes ☐ No If yes, how long _____

VII. Did anyone observe a period of loss of consciousness or unresponsiveness? ☐ Yes ☐ No If yes, how long _____

VIII. Symptoms (circle all that apply)

- Headache
- Memory Problems
- Nausea/Vomiting
- Irritability
- Ring in the ears
- Dizziness
- Balance problems
- Difficulty Concentrating
- Visual Disturbances
- Other _____



Military Acute Concussion Evaluation (MACE)

Defense and Veterans Brain Injury Center

Examination: (IX – XIII)

Evaluate each domain. Total possible score is 30.

IX. Orientation: (1 point each)

Month:	0	1
Date:	0	1
Day of Week:	0	1
Year:	0	1
Time:	0	1

Orientation Total Score ____/5

X. Immediate Memory:

Read all 5 words and ask the patient to recall them in any order. Repeat two more times for a total of three trials. (1 point for each correct, total over 3 trials)

List	Trial 1	Trial 2	Trial 3
Elbow	0 1	0 1	0 1
Apple	0 1	0 1	0 1
Carpet	0 1	0 1	0 1
Saddle	0 1	0 1	0 1
Bubble	0 1	0 1	0 1
Trial Score			

Immediate Memory Total Score ____/15

XI. Neurological Screening

As the clinical condition permits, check

Eyes: pupillary response and tracking

Verbal: speech fluency and word finding

Motor: pronator drift, gait/coordination

Record any abnormalities. **No points are given for this.**

Significance of Scoring

- Non-concussed individuals have a mean total score of 28/30
- A score less than 30 does not imply that a concussion has occurred
- However, in the absence of baseline testing, a score of 25 or below has shown the best sensitivity and specificity for true cognitive impairment resulting from concussion



Military Acute Concussion Evaluation (MACE)

Defense and Veterans Brain Injury Center

XII. Concentration

Reverse Digits: (go to next string length if correct on first trial. Stop if incorrect on both trials.) 1 pt. for each string length.

4-9-3	6-2-9	0	1
3-8-1-4	3-2-7-9	0	1
6-2-9-7-1	1-5-2-8-5	0	1
7-1-8-4-6-2	5-3-9-1-4-8	0	1

Months in reverse order: (1 pt. for entire sequence correct)
Dec-Nov-Oct-Sep-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan
0 1

Concentration Total Score ____/5

XIII. Delayed Recall (1 pt. each)

Ask the patient to recall the 5 words from the earlier memory test (Do NOT reread the word list.)

Elbow	0	1
Apple	0	1
Carpet	0	1
Saddle	0	1
Bubble	0	1

Delayed Recall Total Score ____/5

TOTAL SCORE ____/30

Notes: _____

Diagnosis: (circle one or write in diagnoses)

No concussion

850.0 Concussion without Loss of Consciousness (LOC)

850.1 Concussion with Loss of Consciousness (LOC)

Other diagnoses _____

Defense & Veterans Brain Injury Center
1-800-870-9244 or DSN: 662-6345



Evaluating Historical mTBI

- Very challenging
- Environment of injury contributes to altered perceptions at time of injury
- Repetitive nature of deployment limits recall of specifics/onset of symptoms

Historical mTBI

- Gather details regarding the event
 - Mission details
 - Mechanism of injury
 - Acute symptoms
- Inquire about post event symptoms and any medical assessment/treatment
- Temporal relationships are key

Loss of Consciousness

- Pretty obvious
- Requires some form of documentation or clear history from witness
- Patient often unable to differentiate from PTA

Post-traumatic Amnesia

- Period of time where the individual is unable to form new memories
- Determine first thing remembered after the injury event
- “Lost time”

Alteration in Consciousness

- Dazed
 - Confused
 - “Seeing stars”
-
- Difficult to differentiate from psychological shock of unexpected explosion

Current Symptomatology

- Screening vs. Ongoing symptoms
- Marked symptom overlap
 - TBI vs. PTSD vs. Pain vs. Depression
- Symptom prioritization is key

Postconcussion Symptoms (PCS)

SOMATIC

- Headache
- Dizziness
- Fatigue – for physical and mental
- Visual Disturbances
- Sensitivity to Noise and Light

COGNITIVE

- Decreased Concentration
- Memory Problems

NEUROPSYCHIATRIC

- Anxiety
- Depression
- Irritability
- Mood Swings

PTSD

Re-experiencing

Avoidance

Social withdrawal
Memory gaps
Apathy

Arousal

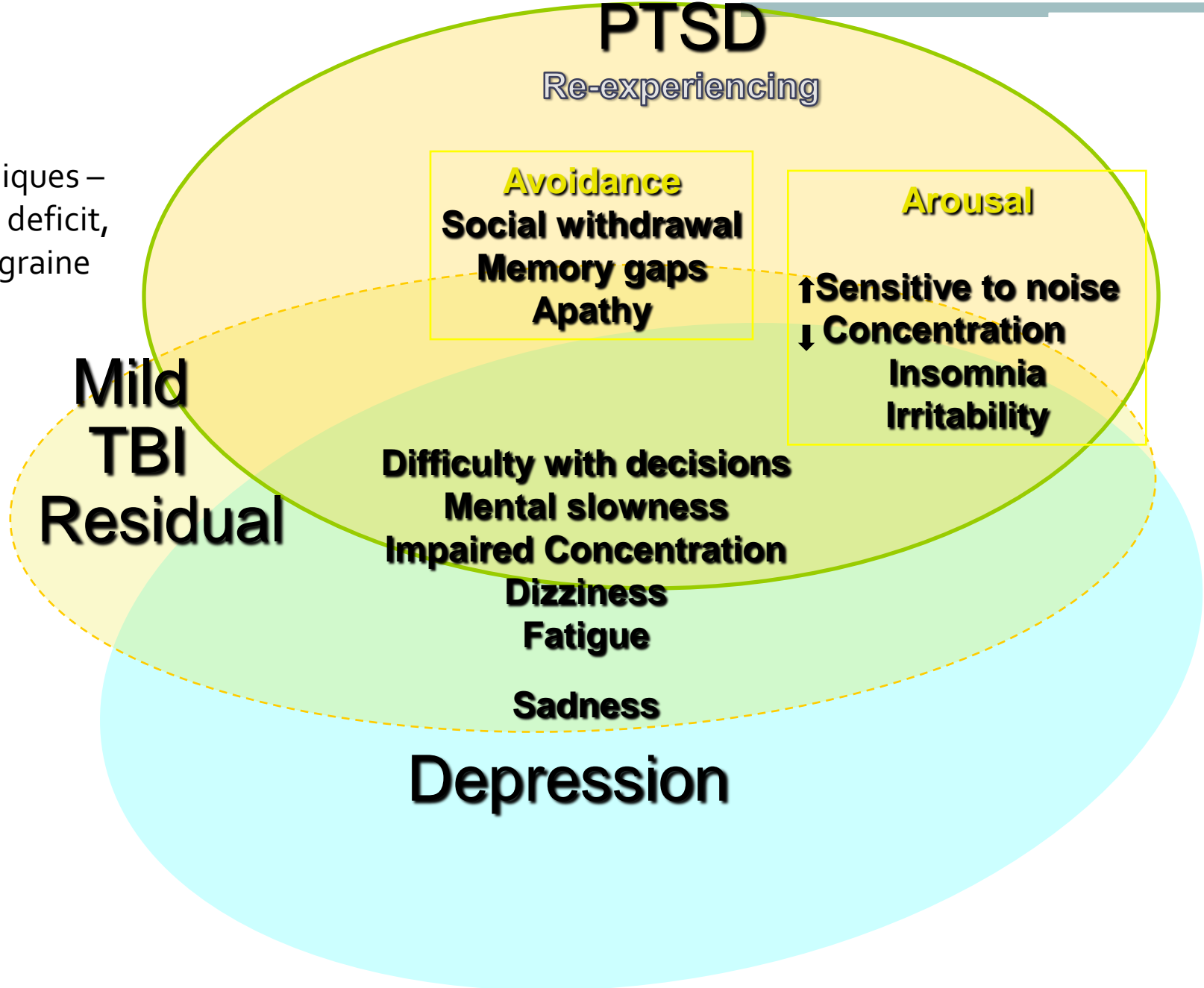
↑ Sensitive to noise
↓ Concentration
Insomnia
Irritability

Difficulty with decisions
Mental slowness
Impaired Concentration
Dizziness
Fatigue
Sadness

Depression

**Mild
TBI
Residual**

TBI uniques –
Neuro deficit,
Sz, migraine



Neurobehavioral Symptom Inventory

- Survey used to quantify post concussive symptoms
- Severity ratings- mild/moderate/severe/very severe
- Understand contextual relevance of severity rating

NEUROBEHAVIORAL SYMPTOM INVENTORY

Please rate the following symptoms with regard to how much they have disturbed you SINCE YOUR INJURY.

0 = None- Rarely if ever present; not a problem at all

1 = Mild- Occasionally present, but it does not disrupt activities; I can usually continue what I'm doing; doesn't really concern me.

2 = Moderate- Often present, occasionally disrupts my activities; I can usually continue what I'm doing with some effort; I feel somewhat concerned.

3 = Severe- Frequently present and disrupts activities; I can only do things that are fairly simple or take little effort; I feel like I need help.

4 = Very Severe- Almost always present and I have been unable to perform at work, school or home due to this problem; I probably cannot function without help.

1. Feeling dizzy:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

2. Loss of balance:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

3. Poor coordination, clumsy:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

4. Headaches:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

5. Nausea:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

6. Vision problems, blurring, trouble seeing:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

7. Sensitivity to light

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

8. Hearing difficulty:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

9. Sensitivity to noise:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

10. Numbness or tingling on parts of my body:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

11. Change in taste and/or smell:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

12. Loss of appetite or increase appetite:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

13. Poor concentration can't pay attention, easily distracted:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

14. Forgetfulness, can't remember things:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

15. Difficulty making decisions:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

16. Slowed thinking, difficulty getting organized, can't finish things:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

17. Fatigue, loss of energy, getting tired easily:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

18. Difficulty falling or staying asleep:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

19. Feeling anxious or tense:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

20. Feeling depressed or sad:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

21. Irritability, easily annoyed:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE

22. Poor frustration tolerance, feeling easily overwhelmed by things:

0	1	2	3	4
NONE	MILD	MODERATE	SEVERE	VERY SEVERE



Physical Exam Pearls in TBI

- Cognitive evaluation probably most important
- Basic neuro exam may be normal even after recovery from moderate/severe injuries
- Add subtleties

Cognitive Screening in the Clinic

- Several brief tools available
 - MoCA, MMSE, SLUMS
- None of the above have effort measures
- Not meant to be Neuropsych level testing

MoCA Test

- Montreal Cognitive Assessment tool
- Free use, www.mocatest.org
- Available in 32 different languages

MoCA Test

MONTREAL COGNITIVE ASSESSMENT (MOCA)

NAME :

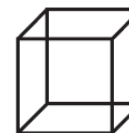
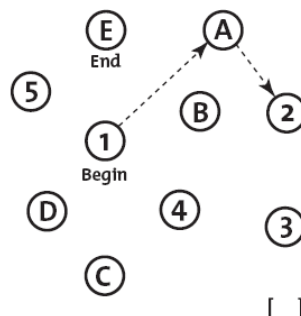
Education :

Sex :

Date of birth :

DATE :

VISUOSPATIAL / EXECUTIVE



Copy
cube

Draw CLOCK (Ten past eleven)
(3 points)

POINTS

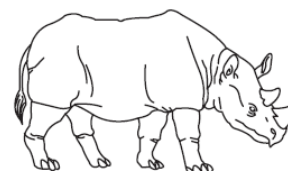
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Contour Numbers Hands

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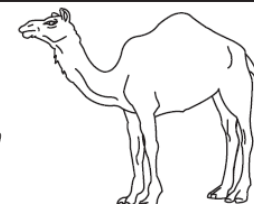
NAMING



[]



[]



[]

___/3

MEMORY

Read list of words, subject
must repeat them. Do 2 trials.
Do a recall after 5 minutes.

	FACE	VELVET	CHURCH	DAISY	RED
1st trial					
2nd trial					

No
points

ATTENTION

Read list of digits (1 digit/ sec.). Subject has to repeat them in the forward order [] 2 1 8 5 4
Subject has to repeat them in the backward order [] 7 4 2

___/2

Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors
[] FBACMNAAJKLBAFAKDEAAAJAMOF AAB

___/1

Serial 7 subtraction starting at 100 [] 93 [] 86 [] 79 [] 72 [] 65
4 or 5 correct subtractions: 3 pts, 2 or 3 correct: 2 pts, 1 correct: 1 pt, 0 correct: 0 pt

___/3

LANGUAGE

Repeat : I only know that John is the one to help today. []
The cat always hid under the couch when dogs were in the room. []

___/2

Fluency / Name maximum number of words in one minute that begin with the letter F [] _____ (N ≥ 11 words)

___/1

ABSTRACTION Similarity between e.g. banana - orange = fruit [] train - bicycle [] watch - ruler

___/2

DELATED RECALL	Has to recall words WITH NO CUE	FACE []	VELVET []	CHURCH []	DAISY []	RED []	Points for UNCUED recall only
Optional	Category cue						
	Multiple choice cue						

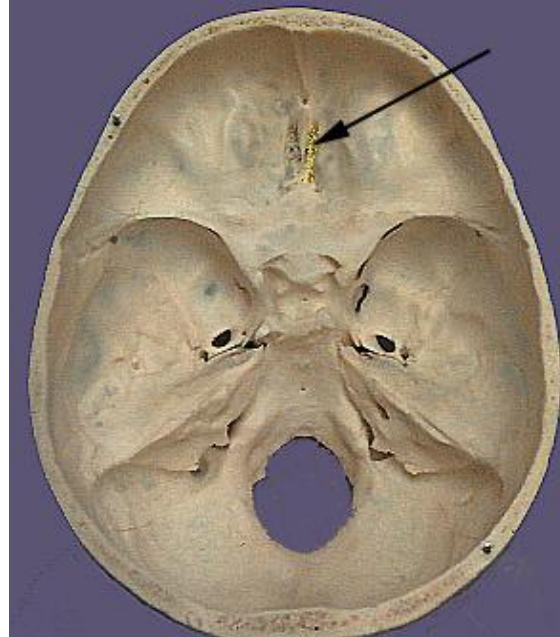
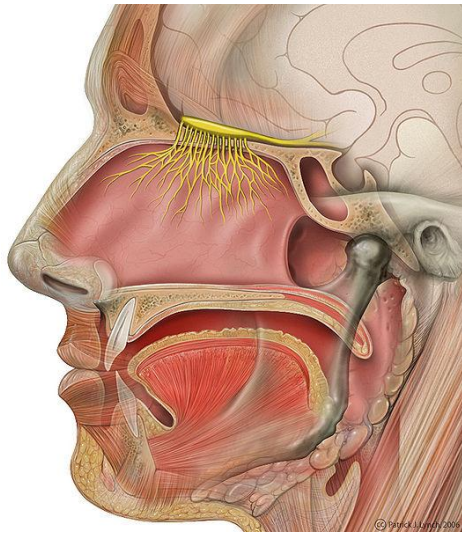
___/5

ORIENTATION [] Date [] Month [] Year [] Day [] Place [] City

___/6

Olfactory Dysfunction

- Regional Vulnerability
- Alcohol swab not acceptable



Vestibular Abnormalities

- Benign Paroxysmal Positional Vertigo
- Unilateral vestibulopathy
- More to come...



Frontal Release Signs

- Glabellar
 - Snout
 - Rooting
 - Grasp
 - Palmomental
 - Paratonia
- Video

Frontal Release Signs

- Work by Hortzel et al. demonstrated correlation between subtle signs and longer LOS, cognitive function and independence measures
- May imply more severe injury if present in long term follow up

Eye Movement Testing

- Recent research demonstrates potential utility in advanced eye movement testing to “confirm” mTBI
- Most tests require ocular tracking devices to detect differences
- However, one group has demonstrated anti-saccade abnormalities in patients with persisting post concussion syndrome

Neuro Exam in mTBI Population

- Ruff RL, et al. JRRD. 2008(7):941-52.
- 126 Blast injured OIF/OEF vets
- mTBI
- Neuro Exam
- Neuropsych testing

Ruff RL, et al.

Table 1.

Frequency of abnormalities on neurological and neuropsychological testing among 80 veterans with mild traumatic brain injury.

Neurological Testing	Neuropsychological Testing	
	Abnormal	Normal
Abnormal	59	6
Normal	15	0

Neuro Deficit	Number
Olfaction	65
Balance	14
Eye movements	13
Motor	2
Sensory	2

Conclusions

- Accurate diagnosis of TBI requires thorough history and examination
- Type of exam depends on the severity of the injury
- Post concussive symptoms have significant overlap and interaction with other conditions
- In the historical evaluation of TBI, neurologic exam should include subtleties

Questions?



References

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